Review of Draft Biological Opinion
Operation of Trinity River Division of the Central Valley Project from 2010 to 2030

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1. Introduction

At the request of the Center for Independent Experts, I have reviewed the *Draft Biological Opinion by the National Marine Fisheries Service, Southwest Region, for Operation of Trinity River Division of the Central Valley Project from 2010 to 2030* (henceforth, the 'BO'). Overall, I found the document to be well-written and a good summary of a wide range of relevant issues, but with some gaps described below. The BO provides evidence to support its conclusion.

In my review, I focused only on aspects of the document for which I had some expertise, primarily geomorphology and hydrology with a long-standing interest in salmonid habitat, life histories, spawning gravels, and in instream flow assessments. I also focused on the aspects of the document for which I could consult relevant sources in an effort to answer the questions posed for the review.

In the following sections, I consider the questions posed in light of scientific literature with which I am familiar. I suggest a few places where revisions could clarify the text, but I did not suggest revisions in all such points where the text could be improved.

2. Does the draft biological opinion incorporate and utilize the latest scientific information on climate change into the analysis of impacts from the project through the year 2030?

The basic approach used in the analysis of climate change in the BO seems reasonable. For estimating climate change, the BO deliberately selected a high emission scenario and a global climate model with relatively high sensitivity to greenhouse gases. Although this conservative approach can be justified on policy grounds, from a scientific point of view it might seem to invite challenge. However, the choice seems justified by the observed rate of increase in greenhouse gases, described by Raupach et al. (2007), and in light of very recent reports such as Clement et al. (2009) that provide reason to think that most existing models may not be sensitive enough.

The details of the implementation of the approach seem more questionable. The details of the modeling involved are not well described, and the main source cited by the BO is a rather obscure USBR report that deals with a different topic. This is probably just a matter of someone copying the wrong citation from a list, but it does not inspire confidence. The real source for the climate data used probably is the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset (see http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/dcpInterface.html#Welcome), but this is not acknowledged. The report would be strengthened by a better description of how the climate projections were developed. The report would also be improved by citation and discussion of other relevant studies such as Dettinger (2005). On a minor point, linear regression gives a poor fit to the temperature data in Figure 6-6a, in that the residuals are mostly negative in the years from about 1975 to 1990, and mostly positive in the period following. A better trend line could be fit using LOWESS.

3. Does the draft biological opinion incorporate and utilize the latest scientific information on the effects of hatchery fish on listed fish?

The draft biological opinion reasonably reflects the latest scientific information on the effects of hatchery fish on listed fish, but the draft could be strengthened in several particulars. The language at p. 4-19, section 4.5.2, and at p. 6-43, could be strengthened by including the *quantitative* finding regarding loss of fitness by Araki et al. (2007), and also by RSRP (2004), which is cited and updated by Araki et al. (2007). This makes it clear that the problem is real, and not some esoteric academic concern. Although an argument can be constructed that coho may lose fitness as rapidly in hatchery culture as steelhead because hatchery culture does not change the normal age at ocean entry for coho, nevertheless the Hood River steelhead results presented by Araki et al. (2007) are the best available for salmonids. The draft could also make more of the data in Table 6-2. These provide strong evidence that the concerns about hatcheries expressed in the general literature applies to the upper Trinity River coho in particular.

On some minor points, the draft could also cite Myers et al. (2004), who are highly qualified. Similarly, the interaction between harvest and hatchery influence should be described, perhaps citing Goodman (2004; 2005). The statement at p. 2-7 that "The hatchery serves as mitigation for 109 miles of lost anadromous habitat upstream of the dams (USFWS et al. 2000)" describes the intended purpose of the hatchery, not what it actually does. The sentence should be revised to make this clear. The same is true for language at p. 6-75. The citation to Heath et al. (2003) regarding egg size seems questionable. Several comments by well known scientists challenged this report, so until the basic finding that hatchery culture selects for smaller egg size is duplicated by others, it is a somewhat weak conclusion. The discussion of ocean conditions at pp. 4-21-22 could be strengthened by citing articles that apply directly to SONCC, such as Botsford and Lawrence (2002) and Botsford et al. (2005). At p. 5-29, it is curious that the discussion of risk of extinction, section 4.11.5, does not discuss the heavy influence of hatchery fish, especially since this is considered explicitly by Williams et al. (2008) in terms of the viability of populations. The citation to Essington et al. (2000) at p. 4-43 seems to be a mistake; that article is about bass. The risk from hatchery influence discussed at p. 6-46 would seem to be more from loss of fitness than loss of genetic diversity. Arguably, by increasing the frequency of alleles that normally are selected against in the wild, hatchery strays could increase genetic diversity. It might be better to deal the threat from hatchery fish in terms of productivity, rather than genetic diversity.

4. Does the draft biological opinion utilize the concepts of viable salmonid populations and the population structure of listed coho salmon?

The draft biological opinion does properly analyze the effects of the project on the SONCC coho in terms of the concepts of viable salmonid populations and population structure. As developed by McElhaney et al. (2000), the "viable salmonid population" concept incorporates four parameters: abundance, population growth rate, population spatial structure, and diversity. The status of the populations affected by the project has recently been analyzed in terms of these parameters by the Technical Recovery Team for SONCC coho (Williams et al. 2008), and the draft biological opinion properly follows their lead.

5. Does the biological opinion represent the best scientific information available?

The draft biological opinion does reasonably represent the best scientific information, with a few lapses. Probably the weakest part of the BO is the dependence on PHABSIM for analyzing the effects of changes in the flow regime on the SONCC coho, as discussed below.

5.1. Use of PHABSIM to analyze effects of flow regime changes

While PHABSIM was a pioneer habitat selection model when developed in the 1970s, procedures have advanced substantially since then in other fields such as ecological modeling. Many of the technical problems with PHABSIM have been discussed in the scientific literature, and were reviewed by the National Research Council Committee on Hydrology, Ecology, and Fishes of the Klamath River Basin (NRC 2007), of which I was a member. Some of the following discussion is adapted from text I contributed to the committee report.

PHABSIM has always been controversial, often because the habitat model was applied without incorporating it within the more comprehensive decision-making framework of the Instream Flow Incremental Methodology (IFIM) (Bovee 1982). PHABSIM applications often use out-of-date methods that may affect the accuracy and credibility of results.

As discussed by Kondolf et al. (1999), the spatial resolution (cell size) used in PHABSIM studies is not selected for biological reasons, but for hydraulic modeling convenience, and the field observations used to generate fish habitat criteria are at a very different spatial resolution than the hydraulic model uses. Instead of thinking about and testing which habitat variables are important to include, if they fail to include the comprehensive framework of IFIM, PHABSIM-based instream flow studies often assume *a priori* that a few variables (usually depth and velocity and, sometimes, substrate type) are the only important habitat variables.

Many PHABSIM studies have attempted to develop habitat suitability criteria from observations only of habitat occupied by fish, without considering the availability of unoccupied habitat. There is no way to make a meaningful model using data only from occupied habitat without also knowing how much of what kinds of habitat were available but not occupied (Manly et al. 2002). Instead of explicitly modeling the density of fish in each cell, PHABSIM produces a “weighted usable area” (WUA) output. While similar to a density model, WUA has no clear meaning, cannot be tested against field observations, and its applicability to management decisions is unclear.

For example, there is no basis for assuming that a doubling of WUA would double the survival, growth, abundance, or biomass of some lifestage. The statistical modeling approach of PHABSIM, based on univariate "suitability curves" multiplied together, is less powerful than modern methods (Guay et al. 2000; Ahmadi-Nedush et al. 2006). The assumptions that all habitat variables have equal effects and that there are no interactions among variables are unnecessary and unlikely. The parsimony and overfitting issues are rarely addressed explicitly. Unlike conventional statistical model-fitting methods, the suitability criteria approach does not facilitate evaluation of model uncertainty. For example, PHABSIM suitability criteria are virtually never accompanied by goodness-of-fit statistics.

Even when the most up-to-date methods are used, habitat selection modeling has inherent limitations that have received widespread recent attention in general (e.g., Garshelis 2000; Burgman et al. 2001) and specifically in reference to instream flow assessment (e.g., Orth 1987; EPRI 2000; Railsback et al. 2003). The fundamental assumption that populations respond in proportion to the availability of highly selected habitat is not well supported (Railsback et al. 2003). Fish populations are limited in part by factors (especially, food availability) other than physical habitat. Competition within and among species for habitat can cause habitat selection models to be misleading. Habitat created for small fish can be occupied instead by larger fish or fish of another species (reported in field studies by Loar et al. 1985).

Habitat selection models are static; they do not consider time and are not suited for predicting effects of habitat changes over time. This limitation is increasingly a problem as instream flows are increasingly managed to reproduce natural variability over time. Habitat selection models produce different results for different life stages and different species, but there is no consistent, satisfactory way to combine these results into a meaningful prediction of overall effects on a species or community. For example, a change in flow might be predicted to double the area of selected habitat for salmon fry but halve the selected habitat area for larger juveniles; these results by themselves give us no way to predict the overall effect on production of salmon.

Sampling problems with a Klamath River study by the same authors have been noted by Williams (2009), although they are somewhat less severe for the Trinity River study, which modeled about 12% of the length of river to which the results were applied. More fundamentally, PHABSIM depends on the assumption that microhabitat preference does not change with flow (Kramer et al.1997), and this assumption is contradicted by many studies. For example, in a study of brown trout, Heggenes (2002) reported that (p. 296): "The results here indicate habitat use is wide and inconsistent, especially for focal velocities, at different streamflows or locations within stream or among streams." Figure 1 (reproduced directly from Heggenes 2002) shows different microhabitat preferences depending upon flow. Change in habitat selection by salmonids with discharge has also been shown for salmonids by other field studies (Vondracek and Longanekcer 1993; Shirvell 1994; Pert and Erman 1994; Greenberg 1994) and by laboratory-stream studies

(McMahon and Hartman 1988; Campbell 1998; Holm et al. 2001; Kemp et al. 2003). The reasons for this have been clarified by simulations (Railsback et al. 2003). Thus, microhabitat preferences are influenced by context, notably flow, an insight that can only undermine confidence in the simplistic assumptions upon which PHABISM is based.

5.2. Relevance of Unimpaired Flow Comparison Given Change in Available Habitat

Apart from the difficulties with PHABSIM, of which NMFS seems somewhat aware (caveat at p. 7-83), it is hard to understand the logic of some of the resulting analyses. For example, on p. 7-94, the BO compares the spawning areas available in the upper Trinity River with the proposed and with unimpaired flow regimes. The unimpaired flows seem relevant only for the hypothetical case that the dams were not there, and if that were the case, the fish would be spawning elsewhere. The same point can be made regarding fry and juvenile rearing.

5.3. Temperature-Related Mortality

Another significant lapse from the use of the best available scientific information concerns the model used to estimate temperature-related mortality in gametes and during the incubation stage of the life-cycle. Fortunately, the analysis in the BO does not depend substantially on this model, or the issue would be more serious. Nonetheless, for the BO to be based on best available science, it would need to distance itself from this discredited model. If it is to be used by the BO, the document should clearly indicate the problems identified with the model, and should reference the discussion of it in Appendix L of the OCAP Biological Opinion.

The questionable model is the same as used for the OCAP Biological Opinion (briefly described in Appendix L of that document). Apparently the model was developed by consultants working with various resource agencies, and is described in a consultant's report (HCI 1996). However, the HCI model draws heavily on an earlier model develop by the Bureau of Reclamation (USBR 1991). This model was severely criticized in a CALFED review of an earlier version of the OCAP BO (Anderson et al. 2005), because the data on which it was based were confounded by serious water quality problems. According to Anderson et al. (2005):

> Third, and most serious, the data used to develop the relationships between temperature and mortality on eggs, alevins, and especially gametes was not the best available. According to LSalmon-2 model documentation (Bureau of Reclamation 1991), the pre-spawning egg (gamete) mortality data came from batches of eggs at Nimbus Hatchery in 1956 (Table 1 in Hinze et al. 1956). Hinze et al. (1956) is a report of the first year of operation of Nimbus Hatchery on the American River, and the report notes that severe water quality problems occurred in the American River in 1955. The poor water quality was due to the partial filling of Folsom Reservoir with relatively warm water, and from high oxygen demand and sulfides from decaying

vegetation in the new reservoir. Similarly, the relationship between temperature and alevin mortality used in the model apparently was based on the opinions of hatchery managers, rather than experimental data. In addition, the Panel was also unable to reproduce the various calculations reported in the model documentation that converted the original pre-spawning egg survival as a function of temperature into daily mortality rates.

Problems with the model are evident in Table 1, which is copied directly from HCI (1996). If the table were anywhere near correct, Chinook salmon could not occur in many streams where they do. For example, Williams (2006) reports temperature data for Butte Creek, which supports a robust population of spring Chinook. Comparing Table 1 from HCI (1996) with Figure 2 (reproduced from Figure 6.6 in Williams 2006) illustrates the problem (recall that 59°F = 15°C). If the HCI (1996) temperature thresholds were correct, the Butte Creek population could not persist, as summer temperatures exceed the HCI (1996) mortality thresholds regularly. In fact, the Butte Creek population is arguably the healthiest in the Sacramento River system. While Williams (2006) reported that there was evidence of damage to gametes in 2002, the median July daily average temperature in that year was over 20°C (68°F).

6. Editorial Issues and Minor Points

The draft could be improved by better editing. Some of the language is repetitive, for example at pp. 4-17 and 4-18, regarding the number of hatchery and natural SONCC coho. Some of the language does not say what it means, such as this sentence at p. 6-54: "Substantial timber harvesting has occurred throughout the ESU." The reference list is not in complete alphabetical order. No one has gone through and replaced citations to Williams et al. (2007) with citations to Williams et al. (2008). The term "in vitro" is misused. It is not a fishery equivalent of "in utero;" it means "in glass," as in a test tube. Also, Julian dates are more complicated than implied by Figure 6-3. The Julian date is the interval of time in days and fractions of a day since January 1, 4713 BC Greenwich noon, not just the number of days since December 31. The term 'historic' refers to something important in history (e.g., Gettysburg was historic), while the term 'historical' applies more broadly to events in the past (e.g., historical land use), but these terms are so commonly mixed up, it is probably not worth fixing.

The sentence beginning "The bedrock…" on p. 6-57 is unclear. Clarify how the bedrock 'supports' natural pool-riffle formation and how this would tend to buffer mining effects. Human population is not 'tempered' by public land (p.6-58), but rather its effects may be.

The BO (p. 6-60) refers to 245-350,000 af "diverted from the Klamath River to the Sacramento River each year as part of the Klamath Project (NMFS 2007)." There is no citation for NMFS 2007 in the References section, and I am not familiar with this diversion. For such a significant diversion, the BO should provide details of point of diversion, method of diversion, etc. Of course, there are the significant diversions from the Trinity River (part of the Klamath) to the Sacramento by the Trinity Division of the Central Valley Project, whose impacts are the motivation for this document. However, the diversion referred to on p. 6-60 is stated to be part of the "Klamath project" so would not be the same.

Even prior to the CVP, the Trinity River was largely bedrock controlled and along most of its length, its floodplain was laterally constricted by bedrock, and much of it was (is) better described as bedrock canyon. The characterization on p.6-69 is correct in that the pre-CVP Trinity River was dynamic, and that seems to the essential point. But the BO would be strengthened were it to acknowledge the importance of natural bedrock control and not to imply that it was formerly a fully alluvial river.

Second paragraph on p. 6-71 doesn't seem to say what I assume it means to. Suggest revising along these lines: "Peak flow at Hoopa was derived from rainfall runoff and historically occurred two months earlier than the peak flow at Lewiston, which was dominated in most years by snowmelt runoff (Moffett…USFWS..) Relatively minor snowmelt runoff is still generated…"

Likewise, last paragraph on p. 6-74 is not quite right. Suggest revising, "Despite historically increase delivery of sediment to the river from hydraulic mining, dredging, logging, and road building, there is a decreased availability of spawning gravels needed by spawning coho. Larger particles…HVT 1999). As a result, the river bed below Lewiston Dam has become armored, with coarse particles that may be too large for spawning salmon to mobilize, and with an interlocked structure that is difficult to dislodge." The sentence "Despite flow re-regulation…Pasternack 2008)" needs to be translated into a more comprehensible statement of the specific impacts that are meant – it's now too vague, lots of big words.

Similarly, on p. 6-79, in paragraph beginning "An over-supply…", revise "…Program was implemented to reduce supply of fine sediment to the mainstem, and thereby improve habitat…"

I doubt floods were ever common in October, as normally it takes considerable antecedent precipitation before significant runoff. I would expect most of the annual rainfall-runoff peaks were in Dec and Jan pre-dam. The paragraph on hydrologic effects on p. 7-88 implies that there were floods as early as October.

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Table 1. Copied from HCI (1996)

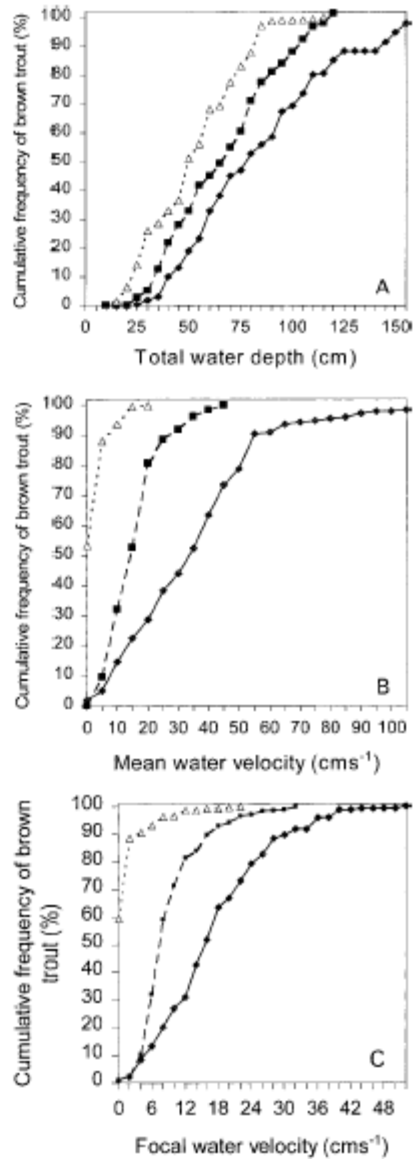
Table 1. Estimated temperature and exposure duration-mortality relationships for pre-spawned chinook salmon eggs (in the adult spawner). Instantaneous mortality rates represent the pre-spawned egg criteria (PSC) currently used by the mortality model.

Incubation Temperature (°F)	Mortality Rate at Exposure Time	Instantaneous Daily Mortality Rate[a] (%)
< 52	Natural rate	--
52	Natural rate	--
53	11% @ 30 days	0.034
54	15% @ 30 days	0.171
55	20% @ 30 days	0.351
56	25% @ 30 days	0.540
57	31% @ 30 days	0.783
58	39% @ 30 days	1.135
59	48% @ 30 days	1.581
60	57% @ 30 days	2.094
61	65% @ 30 days	2.627
62	74% @ 30 days	3.348[b]

[a] Using formula derived by Bartholow 1992 (USFWS memorandum to USBR dated March 13, 1992).

[b] Same mortality rate applied for greater temperatures.

Figure 1. Temporal changes in wild brown trout habitat use of (A) water depths, (B) mean water velocities, and (C) and focal water velocities, in relation to variable stream flows (low [triangles], normal [squares], high [diamonds]) in the Hjartdøla River (N 5 760). (Copied from Heggenes 2002.)



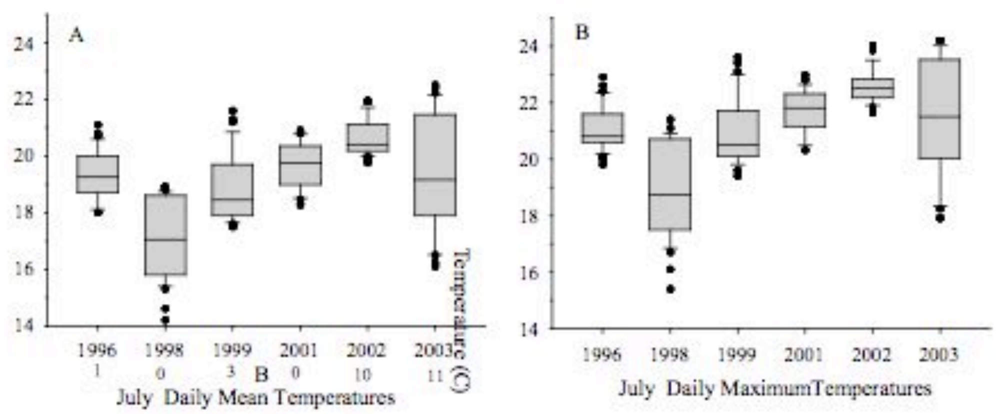


Figure 2. Daily mean (A) and daily maximum (B) water temperatures at the Pool 4 monitoring site in the reach of holding habitat on Butte Creek: The number of days with mean > 21°C in each year is shown below the date in A. Data from CDWR and CDFG. July 2002 was consistently warm; July 2003 was cool early but warm later. Reproduced from Figure 6.6 in Williams (2006)

Appendix I: Statement of Work

External Independent Peer Review by the Center for Independent Experts

Biological Opinion for the Trinity River Division of the Central Valley Project

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract to provide external expertise through the Center for Independent Experts (CIE) to conduct impartial and independent peer reviews of NMFS scientific projects. This Statement of Work (SoW) described herein was established by the NMFS Contracting Officer's Technical Representative (COTR) and CIE based on the peer review requirements submitted by NMFS Project Contact. CIE reviewers are selected by the CIE Coordination Team and Steering Committee to conduct the peer review of NMFS science with project specific Terms of Reference (ToRs). Each CIE reviewer shall produce a CIE independent peer review report with specific format and content requirements (**Annex 1**). This SoW describes the work tasks and deliverables of the CIE reviewers for conducting an independent peer review of the following NMFS project.

Project Description: The U.S. Bureau of Reclamation (BOR) proposed to operate the Trinity River Division of the Central Valley Project until 2030. The Project includes facilities to store, divert, and distribute water for irrigation, power generation and fish and wildlife mitigation and protection. The project blocks access to 109 miles of anadromous fish habitat on the Trinity River located upstream of the dam. The amount of water proposed to be diverted from the Trinity River to the Sacramento River equates to approximately 743,243 acre-feet, or 54% of average annual inflow to the Trinity River.

The Trinity River is the largest tributary to the Klamath River, draining approximately 7,690 km^2 in California. The Klamath River system is the second largest river system in California draining approximately 26,000 km^2 in California, and 14,000 km^2 in Oregon. It once supported large anadromous populations of fall and spring run chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), steelhead (*O. mykiss*) as well as Pacific Lamprey *(Lamptera tridentata)*, and green sturgeon (*Acipenser medirostris*) that supported commercial and recreational fisheries, as well as cultural, subsistence, and commercial needs of native tribes throughout the region.

In 1957 construction began on the Trinity River Division of Bureau of Reclamation's Central Valley Project (CVP), which transfers water from the Klamath Basin to the Sacramento Basin. The Division consists of a series of dams, lakes, power plants, a tunnel, and other related facilities. Lewiston Dam, part of the CVP, was constructed in 1963 near Lewiston, California and is now the upper limit of anadromous fish migration on the Trinity River. At times, 90% of the of the Trinity River flow was diverted to the Sacramento Basin, contributing to the decline of chinook salmon and coho salmon. These water withdrawals, which extracted a large portion of Trinity River water, caused severe degradation to fish habitat of the Trinity River. Trinity River Hatchery (TRH), located at the base of Lewiston Dam, was constructed to mitigate for the loss of 109 miles of anadromous fish habitat upstream of the dam. However, the hatchery does not mitigate for habitat altered or lost downstream of the dams. Trinity River Hatchery releases roughly 4.3 million Chinook salmon, 0.5 million coho salmon and 0.8 million steelhead annually.

Out of concern for declines in anadromous fish populations, Congress enacted the Trinity River Fish and Wildlife Restoration Act (P.L. 98-541) in 1984. This act directed the Secretary of the Interior to take actions necessary to restore the fisheries resources of the Trinity River Basin. The Central Valley Project Improvement Act (CVPIA) of 1992 (P.L. 102-575) legislated alterations in the operation of the CVP for the improvement of fish and wildlife habitat and resources.

In December 2000, Interior signed the Record of Decision (ROD) for the Trinity River Mainstem Fishery Restoration Environmental Impact Statement (EIS) and EIR. The ROD, based mainly on the Trinity River Flow Evaluation Study, was the culmination of years of investigations on the Trinity River. The ROD adopted the preferred alternative, a suite of actions that included a variable annual flow regime, mechanical channel rehabilitation, sediment management, watershed restoration, and adaptive management. The EIS/EIR was challenged in Federal District Court. (Westlands Water District, et al. v. United States Dept. of the Interior, 275 F.Supp.2d 1157 (E.D. Cal, 2002)). Initially, the District Court limited increased flows to the Trinity River called for by the ROD until preparation of a supplemental environmental document was completed. On July 13, 2004, the Ninth Circuit reversed that part of the decision, ruling that Reclamation did not need to prepare a supplemental environmental document. (Westlands Water District, et al. v. United States Dept. of the Interior, 376 F.3d 853 (9th Cir. 2004)). Consequently, Reclamation has been and continues to implement the flows described in the Trinity ROD.

This is a controversial federal action with a recent litigious history. The project has large potential implications on the economy of California's Central Valley, coastal communities in California and Oregon, commercial and recreational fisheries in California and Oregon, and tribal and public trust resources. Additionally, the biological opinion will contain new and innovative analyses and assessment models to help quantify hatchery effects on listed coho salmon and the effects of the project on coho salmon habitat.

The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete the work tasks of the peer review described herein. CIE reviewers shall have the expertise, background, and experience to complete an independent peer review in accordance with the SoW and ToRs herein. CIE reviewer expertise shall include hydrology, Pacific salmon hatcheries, and river restoration.

Location of Peer Review: Each CIE reviewer shall conduct a desk review, therefore no travel is required.

Statement of Tasks: Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering committee, the CIE shall provide the CIE reviewer information (name, affiliation, and contact details) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The SoW with ToRs is established by the NMFS Project Contract, and CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents and reports for the peer review. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send by electronic mail or make available at an FTP site the CIE reviewers all necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. The CIE reviewers shall read all documents in preparation for the peer review.

1. Trinity River Flow Evaluation Study (300 pages, much of which can be skimmed)
2. Bureau of Reclamation Biological Assessment (70 pages)
3. Coho salmon viability documents (100 pages)
4. Hatchery background information to be determined (50 pages)

This list of pre-review documents may be updated up to two weeks before the peer review. **Any delays in submission of pre-review documents or reports for the CIE peer review will result in delays with the CIE peer review process, including a SoW modification to the schedule of milestones and deliverables.** Furthermore, the CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein.

Peer Review: Each CIE reviewers shall conduct the independent peer review in accordance with the SoW and ToRs. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review;
2) Complete independent peer review addressing each ToRs (Annex 2).
3) No later than REPORT SUBMISSION DATE, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Die, CIE Regional Coordinator, via email to ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2;
4) CIE reviewers shall address changes as required by the CIE review in accordance with the schedule of milestones and deliverables.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

21 August 2009	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
21 August	NMFS Project Contact sends the CIE Reviewers the pre-review documents
21 August – 3 September	Each reviewer participates and conducts an independent peer review
4 September	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
18 September	CIE submits CIE independent peer review reports to the COTR
25 September 2009	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be made through the Contracting Officer's Technical Representative (COTR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards: (1) each CIE report shall have the format and content in accordance with Annex 1, (2) each CIE report shall address each ToR as specified in Annex 2, (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon notification of acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the approved CIE reports to the NMFS Project Contact and regional Center Director.

Key Personnel:

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Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations.

2. The main body of the reviewer report shall consist of a Background, Summary of Findings for each ToR, Conclusions and Recommendations in accordance with the ToRs.

3. The reviewer report shall include as separate appendices as follows:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work

Annex 2: Terms of Reference for the Peer Review

Biological Opinion for the Trinity River Division of the Central Valley Project

(i) Does the draft biological opinion incorporate and utilize the latest scientific information on climate change into the analysis of impacts from the project through the year 2030?
(ii) Does the draft biological opinion incorporate and utilize the latest scientific information on the effects of hatchery fish on listed fish?
(iii) Does the draft biological opinion utilize the concepts of viable salmonid populations and the population structure of listed coho salmon?
(iv) Does the draft biological opinion consider the effects of the project on the habitat of listed coho salmon?
(v) Does the biological opinion represent the best scientific information available?